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FACTORS AFFECTING THE OPERATION OF AUTOMATIC DISHWASHING COMPOUND DISPENSERS

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Natick, Massachusetts

July 1973

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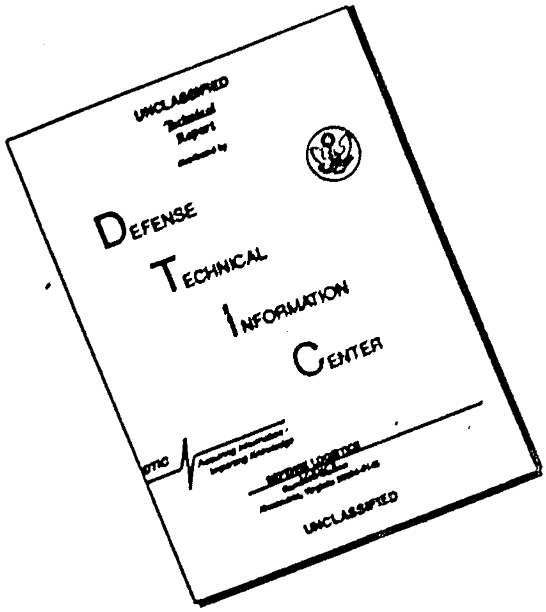

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13. ABSTRACT

Laboratory experiments were performed to gain additional information about the operation of automatic detergent dispensers on Army dishwashing machines. Investigations were directed at determining when dispenser control units should be adjusted and how they are affected by the chemical composition and concentration of dishwashing compounds and by the temperature of the dishwashing solutions.

It was determined that the dispenser need not be re-adjusted when changing from one specification dishwashing compound to another, providing both conform to Federal Specification P-D-425. However, when changing from one commercial product to another, the control unit should be re-adjusted. Adjustment should be made while the electrode is immersed in a solution of the new compound prepared at the desired concentration and maintained at a temperature between 150° and 160°F. (65-71°C.).

The experiments also showed that the temperature of the wash solution should be kept between 150°F. and 160°F. (65-71°C.). If the temperature remains below 150°F. (65°C.), the automatic detergent dispenser will maintain the solution at an excessively high concentration. At temperatures above 160°F. (71°C.), the concentration will be too low. It was also determined that the titration factor to use with the General Services Administration (GSA) detergent test kit (supplied with the GSA automatic detergent dispenser) should be checked by titrating a 0.20 to 0.25 percent solution of the dishwashing compound. This factor, when determined, should be used in subsequent determination of solution concentration.

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FACTORS AFFECTING THE OPERATION OF AUTOMATIC DISHWASHING COMPOUND DISPENSERS

by

H. T. Skerritt

Project Reference:

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July 1973

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FOREWORD

Automatic dishwashing compound dispensers simplify machine dishwashing operations by automatically maintaining a relatively constant and optimum concentration of wash solution. Laboratory experiments were performed to answer questions about the operation of automatic dispensers on Army dishwashing machines. These experiments were concerned with the adjustment of the control unit of these dispensers when changing from one dishwashing compound to another, and with the effect of changes in the temperature of the wash solution.

These tests have contributed to a better understanding of the problems attending the use of automatic detergent dispensers.

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ABSTRACT

Laboratory experiments were performed to gain additional information about the operation of automatic detergent dispensers on Army dishwashing machines. Investigations were directed at determining when dispenser control units should be adjusted and how they are affected by the chemical composition and concentration of dishwashing compounds and by the temperature of the dishwashing solutions.

It was determined that the dispenser need not be re-adjusted when changing from one specification dishwashing compound to another, providing both conform to Federal Specification P-D-425. However, when changing from one commercial product to another, the control unit should be re-adjusted. Adjustment should be made while the electrode is immersed in a solution of the new compound prepared at the desired concentration and maintained at a temperature between 150° and 160°F. (65-71°C.).

The experiments also showed that the temperature of the wash solution should be kept between 150°F. and 160°F. (65-71°C.). If the temperature remains below 150°F. (65°C.), the automatic detergent dispenser will maintain the solution at an excessively high concentration. At temperatures above 160°F. (71°C.), the concentration will be too low.

It was also determined that the titration factor to use with the General Services Administration (GSA) detergent test kit (supplied with the GSA automatic detergent dispenser) should be checked by titrating a 0.20 to 0.25 percent solution of the dishwashing compound. This factor, when determined, should be used in subsequent determination of solution concentration.

FACTORS AFFECTING THE OPERATION OF AUTOMATIC DISHWASHING COMPOUND DISPENSERS

I. INTRODUCTION

Many of the dishwashing machines in Army messes are equipped with automatic detergent dispensers. The purpose of these dispensers is to simplify the dishwashing operation by automatically dispensing and maintaining a relatively constant and optimum concentration of dishwashing compound in the wash solution of the dishwasher. Prior to the installation of these dispensers, or when the dispenser is not operating properly, the dishwashing compound is manually added to the wash solution by the dishwashing machine operator. If these additions are not made at regular intervals, unsatisfactory cleaning and inadequate rinsing could result. Tableware frequently is washed by hand and rinsed and sanitized in the dishwasher because the wash cycle of the dishwasher is not working properly. The installation of an automatic detergent dispenser on a dishwashing machine does not guarantee good cleaning. In addition to maintaining the dishwashing machine in good working condition, the wash solution must be maintained within the optimum temperature range. The setting of the control-signaling unit of the detergent dispenser must be periodically checked to maintain the proper wash solution concentration.

This report includes tests performed by U. S. Army Natick Laboratories to determine the concentration of different dishwashing compounds in wash solutions at temperatures between 120° to 180°F. (49° to 82°C.) when the detergent dispenser control is on one setting.

II. EXPERIMENTAL SECTION

A. Test Dishwashing Compounds - The dishwashing compounds used in these experiments are identified in the Code Sheet.

They include the following specification and commercial products:

Code No.	Class of Product (Federal Stock No. or Commercial)	Specification No. and Type	For Use in Soft-Hard Water
D-1	7930-985-6899	P-D-425, Type I	Hard
D-2	7930-269-1277	P-D-425, Type I	Hard
D-3	7930-985-6906	P-D-425, Type I	Hard
D-4	7930-985-6899	P-D-425, Type I	Hard
D-5	Commercial	--	Hard
D-6	7930-269-1278	P-D-425, Type II	Soft
D-7	7930-267-4932	P-D-425, Type II	Soft
D-8	7930-205-1387	P-D-425, Type II	Soft
D-9	Commercial	--	Soft
D-10	Commercial	--	Soft
D-11	7930-985-6905	P-D-435	Soft
D-12	7930-985-6905	P-D-435	Soft

B. Test Equipment

An automatic detergent dispenser, listed as FSN 7320-011-1699 in the GSA Federal Supply Catalog, was used in the tests (Procedure 3 - Appendix A). This dispenser, identified as Solu-Matic Model 24 manufactured by Economics Laboratory, Inc., includes a detergent reservoir, a solenoid valve to be inserted in the hot water line leading into the reservoir, an electrical control with a signaling device, and a wash solution electrode (conductivity cell).

The dispenser's control unit activates a buzzer and opens the solenoid valve when the conductivity or the concentration of the wash solution in the dishwasher is below the pre-set value. When the solenoid is activated, hot water flows into the detergent reservoir dissolving some of the dishwashing compound and this detergent solution flows into the wash tank. The solution of dishwashing compound flows from the reservoir into the wash solution until the conductivity satisfies the control unit setting. When the buzzer sound for more than 15-20 seconds, a red light appears and stays on, indicating that the reservoir is void of dishwashing compound. The operator must then add powdered detergent to the reservoir.

C. Laboratory Experiments

(1) Experiment No. 1 - Conductivities of Solutions of Dishwashing Compounds, Alkalis, Alkaline Salts and Neutral Salts

Machine dishwashing compounds are mixtures of alkaline compounds, principally, sodium salts of phosphates, silicates, carbonates and sodium hydroxide. Dissolved in water, these compounds are highly ionized. The electrical conductivity of solutions of dishwashing compounds is used as a measure of their concentration. However, the compositions of commercial and federal specification dishwashing compounds are known to differ from each other in the proportions of these alkaline compounds and the conductivity of their solutions.

Questions concerned with adjusting the control setting of detergent dispensers were:

(a) Is it necessary to change these settings when using Federal Specification P-D-425 dishwashing compounds, but changing from one lot to another, or changing from one manufacturer's product to another company's product?

(b) Do minor variations in the chemical composition of dishwashing compounds greatly affect the conductivity of their solutions, so that changes in the control settings are required?

To answer these questions, several experiments were performed. In one experiment, the Solu-Matic Model 24 Detergent Dispenser control unit was adjusted to buzz for 11-13 seconds (Test Procedure 3, Appendix A) when the electrodes were immersed in a 0.2 percent solution of sodium chloride (NaCl) at $149^{\circ} \pm 2^{\circ}$F. ($65^{\circ} \pm 1^{\circ}$C.). Solutions of four Type I compounds (P-D-425), three Type II compounds (P-D-425), two P-D-435 compounds, and three commercial dishwashing compounds (D5, D9 and D10) were prepared at a concentration to equal the conductivity of the 0.2 percent NaCl solution. The concentration of these solutions was determined by titration (Test Procedure 1A, Appendix A) and is recorded in Table I. Total alkalinity values (percent Na_2O) and pH values of 0.3 percent solutions of these compounds are included in this table. The concentration of solutions of Type I compounds varied from 0.25 to 0.28 percent, for Type II compounds from 0.24 to 0.25 percent. The concentration of the solutions of dishwashing compounds

TABLE I

DISHWASHING SOLUTIONS OF EQUAL CONDUCTIVITY*

Dishwashing Compound Code No.	For Use in Hard or Soft Water	Concentration of Dishwashing Solutions of Equal Conductivity % by Weight	Oz./10 Gals.1/	Alkalinity of Dishwashing Compound As % Na_2O	pH of 0.3% Solution at 25°C.
D-1	Hard	0.28	3.7	33.3	11.4
D-2	Hard	0.25	3.3	36.4	11.5
D-3	Hard	0.28	3.7	34.1	11.3
D-4	Hard	0.25	3.3	36.9	11.6
D-5	Hard** #	0.22	2.9	32.5	12.0
D-6	Soft	0.24	3.2	41.3	11.6
D-7	Soft	0.24	3.2	40.0	11.7
D-8	Soft	0.25	3.3	38.0	11.7
D-9	Soft** #	0.19	2.5	44.4	11.7
D-10	Soft**	0.36	4.7	24.0	11.5
D-11	Soft** #	0.20	2.6	32.0	11.9
D-12	Soft**	0.25	3.3	36.7	11.6

* Solution Temperature: $149^\circ \pm 2^\circ$F. ($65^\circ \pm 1^\circ$C.)
** Contains a chlorine bleach
# Contains caustic soda as determined by a spot test
1/ Directions for use (Federal Specification P-D-425) express solution concentrations in ounces per 10 gallons.

D5, D9 and D11 (one of the F-D-435 compounds) was in a lower range : 0.22, 0.19 and 0.20 percent, respectively. These three compounds contain caustic soda ($NaOH$); the others do not.

In another experiment, solutions of caustic soda, alkaline salts, and sodium sulfate were prepared to concentrations so as to equal the conductivity of 0.2 percent solution of sodium chloride at $149^{\circ} \pm 2^{\circ}$F. ($65^{\circ} \pm 1^{\circ}$C.). The concentration of these solutions was determined by weighing the resulting solution and determining the weight of salt used to prepare the solutions. These solutions ranged in concentration from 0.06 percent for $NaOH$ to 0.81 percent for regular borax (Table II). Inspection of these data show that there is no direct relationship between the conductivity of the solution, the alkalinity of the salt, and the pH of a solution of the salt. The two most alkaline materials (caustic soda and sodium orthosilicate) requiring the least concentration to produce a solution of the required conductivity yield large quantities of hydroxyl ions (OH^-) by ionization. With the exception of the proton (H^+), the hydroxyl ion has the greatest conductivity of all the inorganic ions. The conductivity of water solutions of salts and alkaline chemicals depends upon the degree of dissociation into ions, the conductivity of the ions produced, and the degree of hydrolysis to form weak acids and hydroxyl ions. These effects are additive and the sum of these effects determines the conductance of the solution.

(2) Experiment No. 2 - Solution Concentration and Conductivity

In another experiment, 0.1, 0.2 and 0.3 percent solutions of four dishwashing compounds, D1, D6, D9 and D10, were prepared. The exact concentrations were determined by analysis. Conductivity measurements of these solutions were performed at a temperature of 140°F. (60°C.) in accordance with Test Procedure 3, Appendix A. Solutions of sodium chloride were prepared to match the conductivity (same response to control-signaling unit) of these dishwashing solutions. The concentration of sodium chloride solutions in terms of ppm $NaCl$ was determined as outlined in Test Procedure 2, Appendix A. The results are shown in Table III and graphically expressed in Figure I. When solutions concentrations are plotted against solution conductivities in terms of ppm $NaCl$, three straight lines are obtained; Commercial D9 and GSA Type II (D6) compounds are on separate lines and Commercial D10 and GSA Type I (D1) compounds are on the third line. The test data show that there is no direct relationship between the conductivity and the alkalinity of a dishwashing solution.

(3) Experiment No. 3 - Solution Temperature and Conductivity

Question: When the concentration of a dishwashing compound in a wash solution is controlled by an automatic detergent dispenser, how is the concentration affected by changes in the temperature of the wash solution?

A 0.2 percent solution of GSA Type II (D6) dishwashing compound was prepared and heated to a temperature of 160°F. (71°C.). The control-signaling unit of the detergent dispenser was adjusted to buzz for 11-13

TABLE II

ALKALI, ALKALINE SALTS AND NEUTRAL SALT SOLUTIONS OF EQUAL CONDUCTIVITY*

Alkali, Alkaline Salts and Neutral Inorganic Salts		Concentration of Solutions of Equal Conductivity		Alkalinity of Alkaline Chemical Expressed as $\% Na_2O$	pH Value of 1.0% Solutions at 25°C.
Common Chemical Name	Chemical Formulation	% by Wgt.	Oz./10 Gals. 1/		
Sodium Hydroxide	$NaOH$	0.06	0.75	75.5	13.1
Sodium Orthosilicate	Na_4SiO_4	0.09	1.20	60.0	13.0
Sodium Carbonate	Na_2CO_2	0.15	2.00	58.0	11.4
Sodium Chloride	$NaCl$	0.20	2.60	--	6.0
Sodium Metasilicate	Na_2SiO_3	0.21	2.75	51.0	12.7
Sodium Sulfate	Na_2SO_4	0.24	3.15	--	6.0
Sodium Sesquicarbonate	$Na_3H(CO_3)_2 \cdot 2H_2O$	0.28	3.70	41.3	10.0
Sodium Tripolyphosphate	$Na_5P_3O_{10}$	0.29	3.80	17.0	9.7
Sodium Borate	$Na_2B_4O_7 \cdot 10H_2O$	0.81	10.70	16.3	9.2

* Solution Temperature: $149^\circ \pm 2^\circ$F. ($65^\circ \pm 1^\circ$C.)

1/ Directions for use (Federal Specification P-D-425) express solution concentrations in ounces per 10 gallons.

TABLE III

CONDUCTIVITY OF SOLUTIONS OF DISHWASHING COMPOUNDS*

Dishwashing Compound Code No.	Dishwashing Compound Solutions Concentration Percent by Weight (1)	Conductivity Expressed As ppm Sodium Chloride (2)(3)
D-1	0.1	980
D-6	0.1	1020
D-9	0.1	1350
D-10	0.1	890
D-1	0.19	1700
D-6	0.20	2040
D-9	0.19	2850
D-10	0.20	1770
D-1	0.30	2560
D-6	0.30	3170
D-9	0.27	3620
D-10	0.29	2540

* Solution Temperature: 140°F. (60°C.)

(1) Procedure 1A, Appendix A (methyl orange end point)

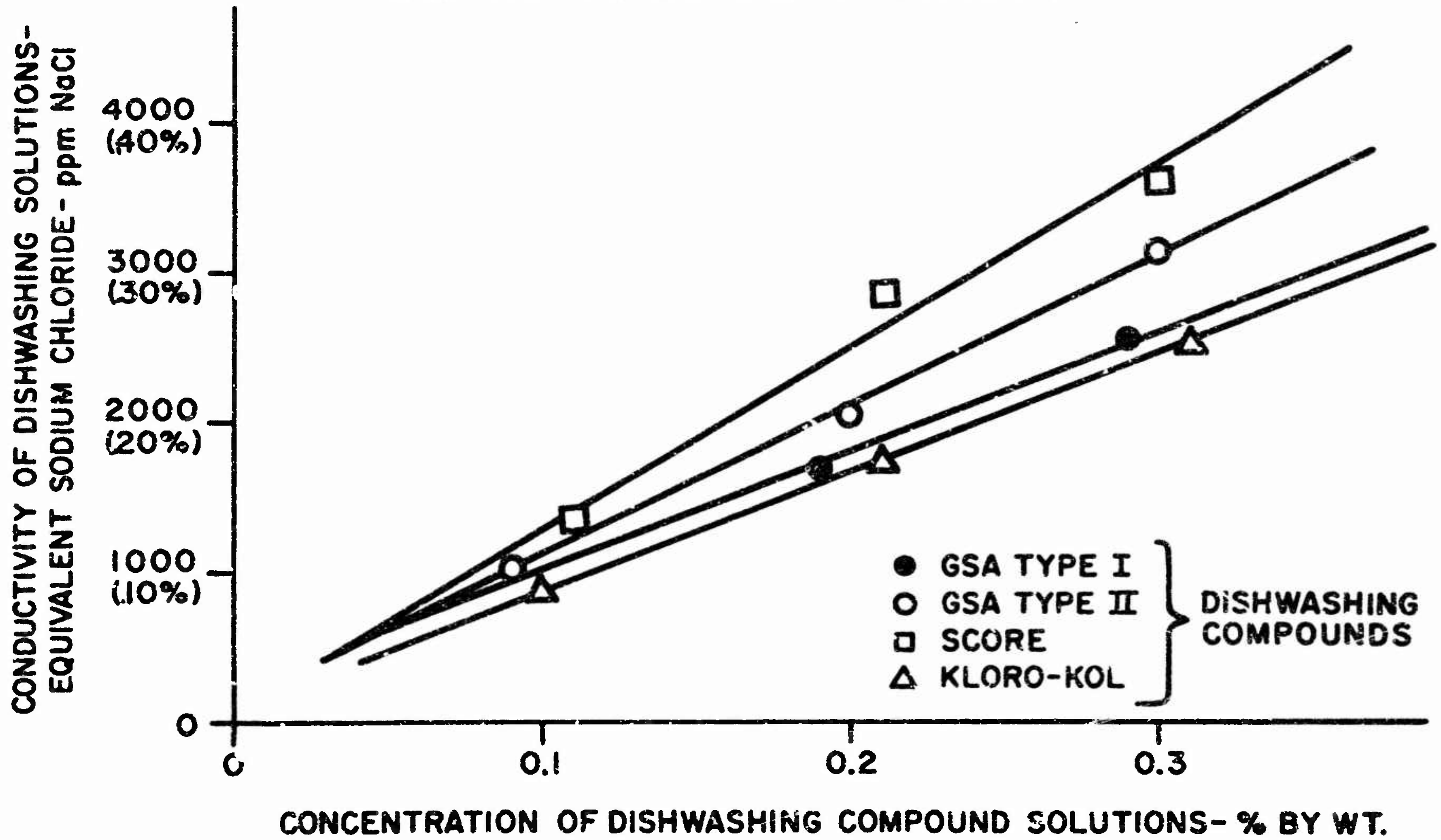
(2) Procedure 3, Appendix A (conductivity control unit of detergent dispenser)

(3) Procedure 2, Appendix A

FIGURE I

CONDUCTIVITY OF SOLUTIONS OF DISHWASHING COMPOUNDS

SOLUTION TEMPERATURE - 60°C (140°F)



seconds when the electrode was immersed in this solution. Using this setting and following Test Procedure 3, Appendix A, other solutions of GSA Type II (D6) dishwashing compound were prepared to give the same response at solution temperatures of 120°F. (49°C.), 140°F. (60°C.) and 180°F. (82°C.). These dishwashing solutions were titrated with 0.5N H_2SO_4, and the concentration was determined in accordance with Test Procedure 1A, Appendix A. A similar test was performed using dishwashing compound commercial D9. The results listed in Table IV and graphed in Figures II and III show that as the solution temperature increases the conductivity increases. Thus, as the concentration of the dishwashing compound decreases the control will not call for more compound to be added to the wash water because of the increased conductivity caused by the increase in solution temperature. The results show the importance of maintaining the dishwashing solution at the proper temperature for effective cleaning and subsequent rinsing as well as for economy.

(4) <u>Experiment No. 4 - Titration Procedures for Determining Solution Concentration of Dishwashing Compounds</u>

The automatic detergent dispenser purchased from the General Services Administration contained a titration kit for determining the concentration of dishwashing solutions based on alkalinity. A 5 ml. sample of wash solution is titrated with an acid solution to a phenolphthalein end-product. The directions state that each drop of titrating acid is equivalent to 0.01 percent of the dishwashing compound. A comparison of the results obtained using NIABS Test Method Procedures 1A and 1B and the GSA Kit Test Procedures 1C (Appendix A) is shown in Table V. In every case, the concentration values obtained with the GSA kit are lower than the values obtained by the NIABS methods. Dishwashing compounds are not equal in alkalinity and a single titration factor* is not applicable to all compounds. Low or erroneous titration values are obtained with the GSA kit when dishwashing compounds containing an oxidizing bleach are tested because the color of the indicator will disappear during titration. The method used by NIABS required that several crystals of sodium thiosulfate be dissolved in the sample solution before adding the color indicator. The sodium thiosulfate reduces the bleach before it can react with the color indicator.

* One drop of GSA acid solution equals 0.01 percent dishwashing compound.

TABLE IV

DISHWASHING COMPOUND SOLUTIONS - CHANGES IN SOLUTION CONCENTRATION AND TEMPERATURE TO MAINTAIN CONSTANT CONDUCTIVITY

Dishwashing Compound Code No.	Dishwashing Solutions - Constant Conductivity (1) and Changing Concentration (Percent by Weight) (2)			
	Solution Temperatures - °F. (°C.)			
	120°F. (49°C.)	140°F. (60°C.)	160°F. (71°C.)	180°F. (82°C.)
D-6	0.29	0.24	0.22	0.17
D-9	0.27	0.22	0.19	0.17

(1) Procedure 3, Appendix A

(2) Procedure 1A, Appendix A

FIGURE II

DISHWASHING SOLUTIONS-CONCENTRATION AND TEMPERATURE CHANGES TO MAINTAIN CONSTANT CONDUCTIVITY

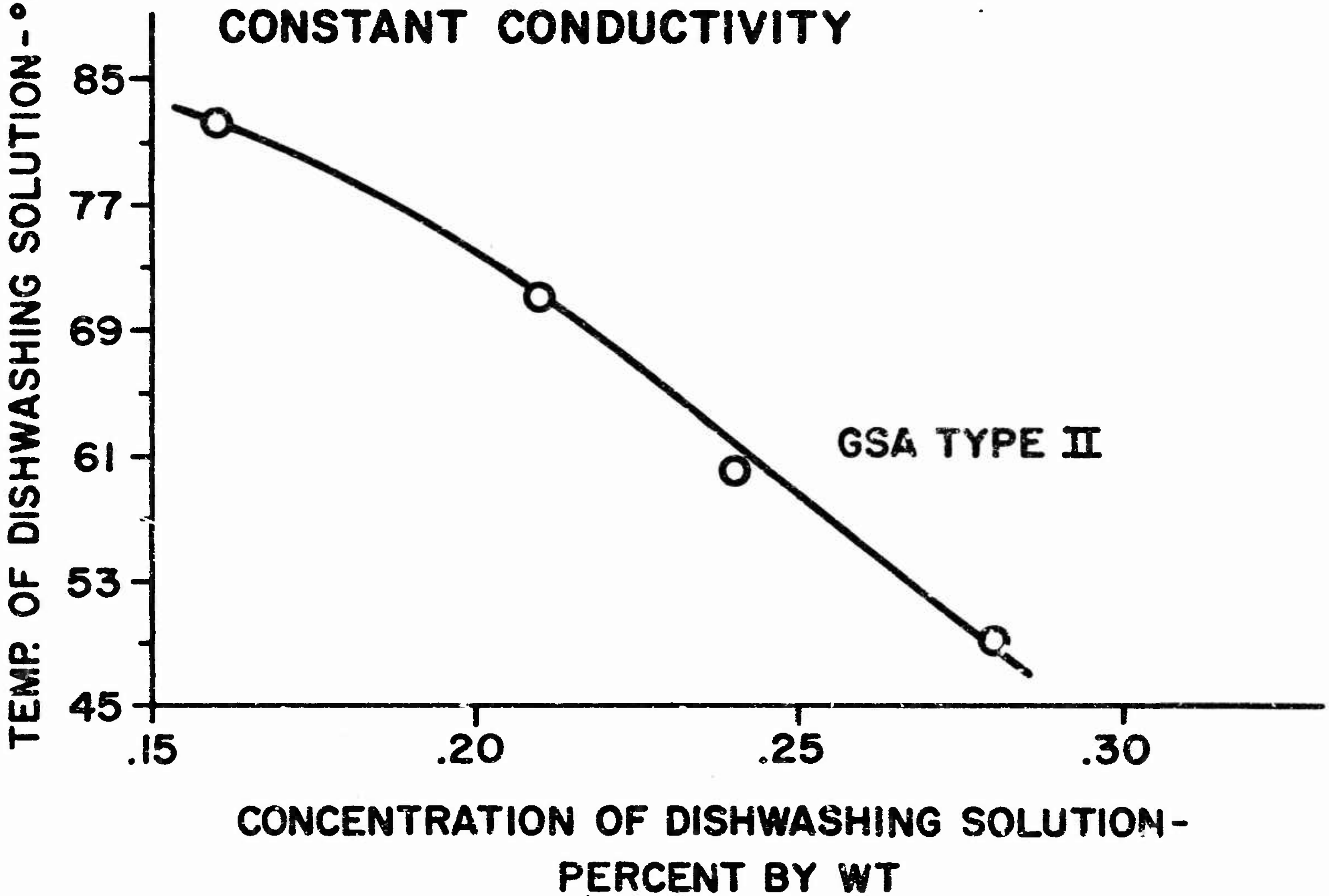


FIGURE III

DISHWASHING SOLUTIONS - CONCENTRATION AND TEMPERATURE CHANGES TO MAINTAIN CONSTANT CONDUCTIVITY

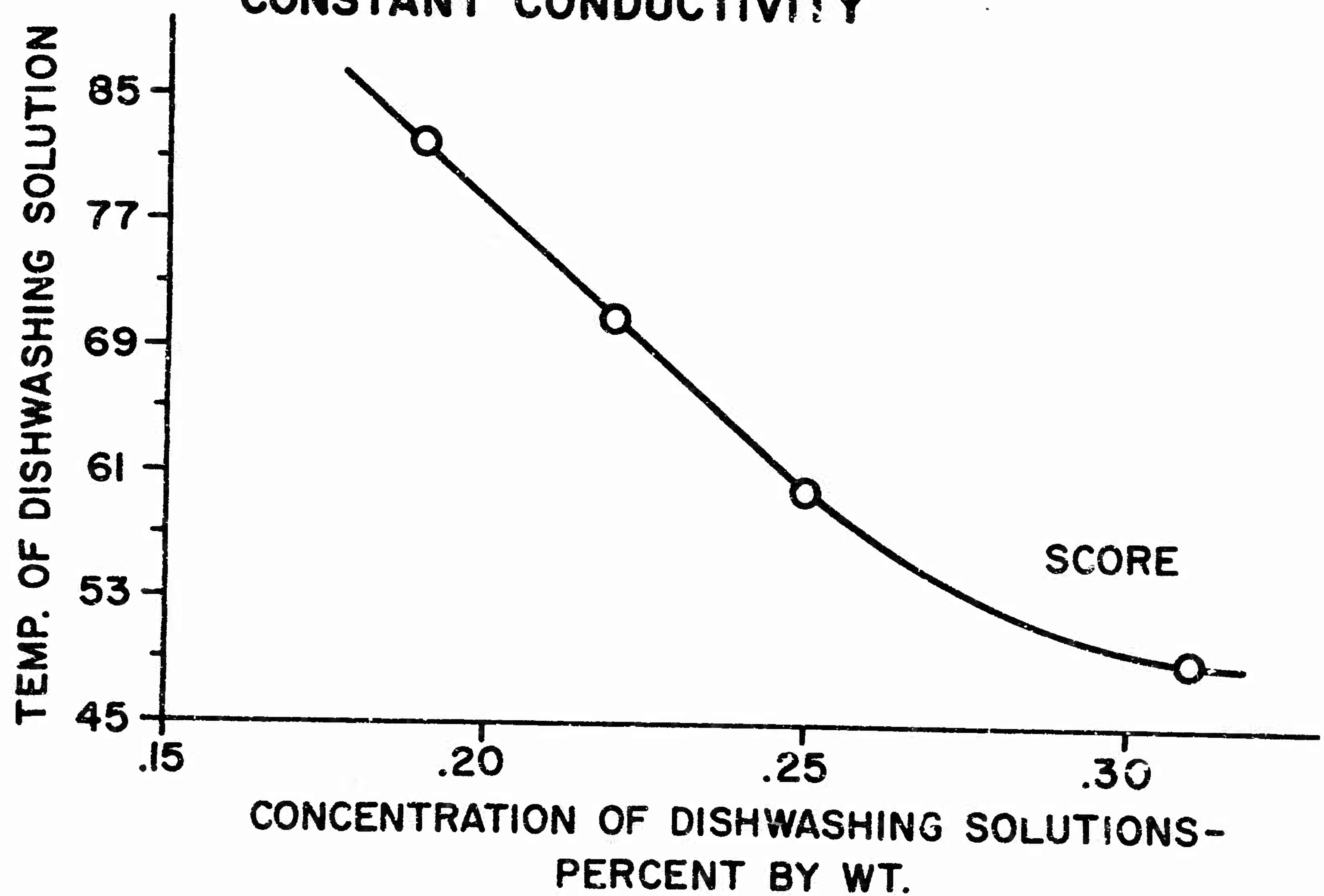


TABLE V

DIFFERENCES IN THE ANALYSIS OF DISHWASHING SOLUTIONS USING DIFFERENT PROCEDURES

Dishwashing Compound Code No.	Titration Data Vol. of 0.5N H_2SO_4, ml.		Concentration of Solutions - Percent		
			NIABS Titrations		
	Phenolphthalein End Point (1)	Methyl Orange End Point (2)	Phenolphthalein End Point	Methyl Orange End Point	GSA Kit Titration (3)
D1	2.2	4.1	0.09	0.10	0.06
D1	4.8	8.2	0.21	0.19	0.12
D1	6.6	12.8	0.28	0.30	0.16
D6	2.9	5.1	0.09	0.10	0.08
D6	6.1	10.6	0.19	0.20	0.15
D6	9.0	16.0	0.28	0.30	0.23
D9	2.7	5.5	0.07	0.10	0.07
D9	6.2	10.6	0.16	0.19	0.14
D9	8.2	15.4	0.22	0.27	0.17*
D10	1.5	3.1	0.09	0.10	0.05
D10	2.9	6.1	0.18	0.20	0.07
D10	4.2	9.1	0.26	0.29	0.10

(1) Procedure 1B, Appendix A

(2) Procedure 1A, Appendix A

(3) Procedure 1C, Appendix A Kit supplied with automatic detergent dispenser when purchased from GSA.

* A value of 0.21 percent was obtained when the titration was performed using sodium thiosulfate as an anti-chlor.

III. CONCLUSIONS

These tests indicate that the control setting on automatic detergent dispensers need not be adjusted each time when changing from one lot of dishwashing compound to another or from one manufacturer's product to another company's product, providing the compound meets the chemical requirements of Federal Specification P-D-425. However, should the dishwashing compound contain caustic soda, and the current specification P-D-425 does not exclude caustic soda, it would be necessary to adjust the controls in order to obtain the desired concentration. Consideration should be given to including in a revision of P-D-425 a conductivity requirement for solutions of dishwashing compounds. When changing from one commercial dishwashing compound to another, it is necessary to make up the wash solution at the desired concentration and at a temperature between 150° and 160°F. (65° and 71°C.) and to adjust the detergent dispenser controls accordingly. The same can be said about the use of Federal Specification P-D-435 compounds on the basis of our limited experience with this product.

When dishwashing machines are equipped with automatic detergent dispensers, it is necessary to maintain the wash solution within a temperature range of 150° to 160°F. (65° to 71°C.) to obtain a relatively constant concentration of dishwashing compound. If the wash solution temperatures fall below this range, the washing solution may become too strong to rinse completely from the tableware and the consumption of dishwashing compound will be excessive. If the wash solution temperature exceeds 160°F. (71°C.), the washing solution may become too weak to adequately clean tableware. The controls of detergent dispensers are activated by electrolytes such as salt ($NaCl$) as well as by the alkali and alkaline salts in dishwashing compounds. For this reason, salty foods should be thoroughly rinsed from tableware during the pre-flushing operation, so that the detergent dispenser will be able to maintain the washing solution at the proper strength.

Low concentration values were obtained with the GSA titration kit because the factor (1 drop equals 0.01 percent detergent) does not apply to all dishwashing compounds. When titrating some strongly alkaline dishwashing compounds, the factor might have to be changed to 1 drop equals 0.005 percent detergent. Low values were obtained with this kit because of the presence of a chlorine bleach in some of the dishwashing compounds. Bleach decolorizes the phenolphthalein indicator and a false end-point is reached before the alkali is neutralized.

APPENDIX A - TEST PROCEDURES

1. Methods for Determining the Concentration of Dishwashing Solutions

1A - NIABS METHOD (METHYL ORANGE INDICATOR)

Into a 300 ml. Erlenmeyer flask, pour 200 ml. of the dishwashing solution. Dissolve several crystals of sodium thiosulfate ($Na_2S_2O_3$) in this solution, then add several drops of methyl orange indicator solution. Titrate this solution with 0.5N sulfuric acid. Record the number of milliliters of standard acid required to neutralize the alkali. Calculate the concentration of the dishwashing compound:

$$\text{Concentration, Percent by Weight} = \frac{0.3A}{F}$$

where: A = ml. of 0.5N H_2SO_4

F = Factor = ml. of 0.5N H_2SO_4 required to titrate 0.6 gram* dishwashing compound to methyl orange end-point

* Factor (F) is determined by dissolving a 60.0 gram sample of dishwashing compound in distilled water and diluting to 1 liter. A 10.0 ml. aliquot is then diluted to 200 ml. with distilled water (200 ml. contain 0.60 grams of dishwashing compound) and titrated with 0.5N H_2SO_4 to a methyl orange end-point.

Factors (F) for some of the dishwashing compounds are:

Dishwashing Compound FSN 7930	Manufacturer	Type	Factors to Use With Indicators: Phenol-phthalein	methyl orange
985-6899	Wash. Chem. Sales	I	7.0	12.9
269-1277	Independ. Chem	I	7.9	14.1
985-6906	Solventol Chem.	I	7.1	13.2
985-6899	Independ. Chem.	I	8.2	14.3
Impact	Economics Lab.	--	9.8	12.6
269-1278	Wash. Chem. Sales	II	9.7	16.0
267-4932	Solventol Chem.	II	9.6	15.5
205-1387	DEX, Inc.	II	9.8	14.7
Score	Economics Lab.	--	11.4	17.2
Kloro-Kol	DuBois Chem.	--	4.8	9.3
985-6905 (1)	Wash. Chem. Sales	--	9.5	12.4
985-6905 (2)	Wash. Chem. Sales	--	8.6	14.2

(1) B135770 P-D-435

(2) B446770 P-D-435

1B - NLABS METHOD (phenolphthalein indicator)

The procedure is identical with the 1A Method, except that the phenolphthalein indicator solution is used in place of methyl orange. The factor to use in calculation concentration of dishwashing solution is shown in the above table.

1C - FIELD METHOD WITH GSA TITRATION KIT

The titration kit supplied with the detergent dispenser consists of two dropping bottles (one with an acid solution and the other with a phenolphthalein indicator solution) and a glass vial with a 5 ml. graduation mark.

Instructions provided with the kit are as follows:

a. Fill vial to line with detergent solution.

b. Add 1 drop of indicator.

c. Titrate with acid solution until pink color disappears.

d. Each 10 drops of the acid solution equals approximately 0.1 percent of detergent.

2. METHOD FOR ANALYSIS OF SODIUM CHLORIDE SOLUTION

Pour 100 ml. of the sodium chloride solution into a 300 ml. Erlenmeyer flask. Add 1 ml. of potassium chromate indicator solution (a 5 percent solution of K_2Cr_40) and titrate solution with a 0.1N silver nitrate solution to a faint, but distinct color change. Calculate the concentration of sodium chloride, NaCl ppm as follows:

Concentration, ppm NaCl = 585 x SXN

where : S = ml. of Ag NO_3 solution

N = normality of Ag NO_3 solution

3. METHOD FOR PREPARING SOLUTIONS OF DISHWASHING COMPOUNDS OF EQUAL CONDUCTIVITY

The following procedure was used to prepare solutions of dishwashing compound of equal electrical conductivity.

Prepare a liter of dishwashing solution of known concentration. Transfer the solution to a wide-mouth glass jar (1 liter capacity) and place the jar in a hot water bath maintained at a controlled temperature. When the solution reaches the desired temperature, immerse the electrode (conductivity cell) of the control signaling unit into the solution and adjust the control unit so that the buzzer operates for a period of 11 to 13 seconds. The 11-13 second buzzing period is considered the end-point of the test. Fill a 1 liter, glass, wide-mouth jar with distilled water to about one-half inch from top. Place the jar in the hot water bath, heat to the desired temperature, and add to this water small amounts of a dishwashing compound, stirring thoroughly to dissolve. After each addition, immerse the electrode in the solution and check the response of the signaling unit. Keep adding dishwashing compound to the solution until the signal buzzer operates for a period of 11 to 13 seconds. This second solution is considered to be equal to the first solution in conductivity.

CODE SHEET

IDENTIFICATION OF DISHWASHING COMPOUNDS

Dishwashing Compound Code No.	Fed. Stock No. or Trade Name	Specification or Commercial	For Use in Soft or Hard Water	Manufacturer of Compound
D1	7930-985-6899	P-D-425, Type I	Hard	Washington Chem. Sales
D2	7930-269-1277	P-D-425, Type I	Hard	Independence Chemicals
D3	7930-985-6906	P-D-425, Type I	Hard	Solventol Chemicals
D4	7930-985-6899	P-D-425, Type I	Hard	Independence Chemicals
D5	Impact	Commercial	Hard	Economic Laboratory
D6	7930-269-1278	P-D-425, Type II	Soft	Washington Chem. Sales
D7	7930-267-4932	P-D-425, Type II	Soft	Solventol Chemicals
D8	7930-205-1387	P-D-425, Type II	Soft	DEK, Inc.
D9	Score	Commercial	Soft	Economics Laboratory
D10	Kloro-Kol	Commercial	Soft	DuBois Chemical
D11	7930-985-6905	P-D-435, (1)	Soft	Washington Chem. Sales
D12	7930-985-6905	P-D-435, (2)	Soft	Washington Chem. Sales

(1) B135770

(2) B446770